# Growth and survival of juvenile coho salmon are related: sometimes

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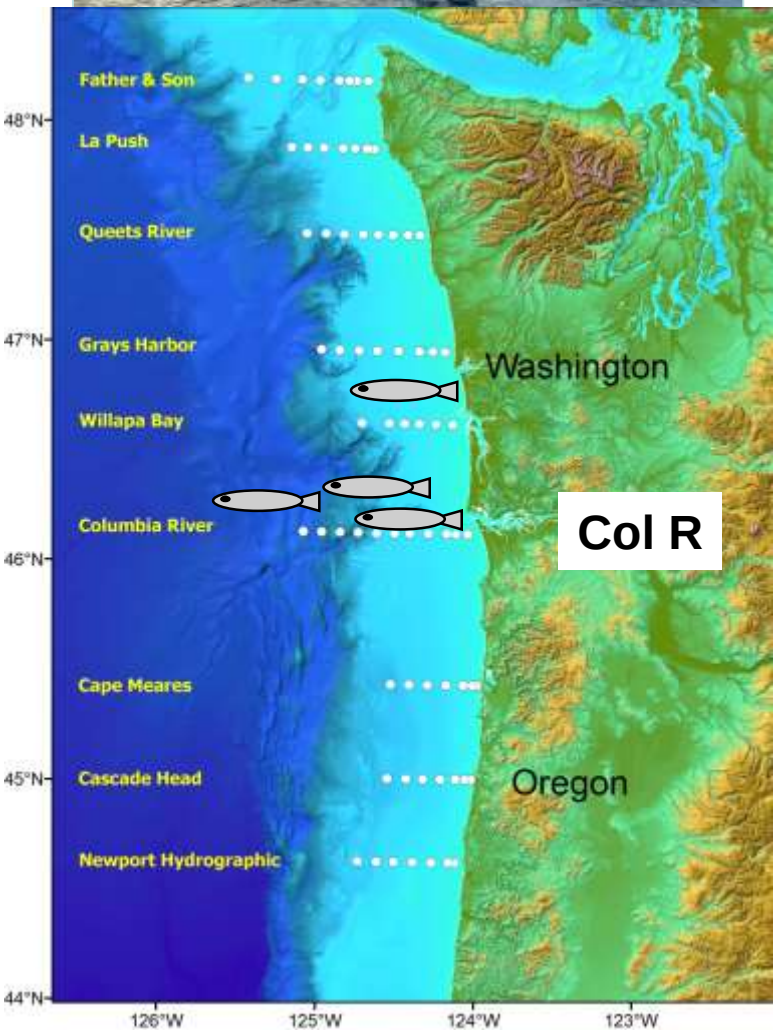
# Outline

- intro
  - the survey
  - coho salmon
- Growth and prey field
- Growth and survival
- June abundance (CPUE)
- attempts to synthesize

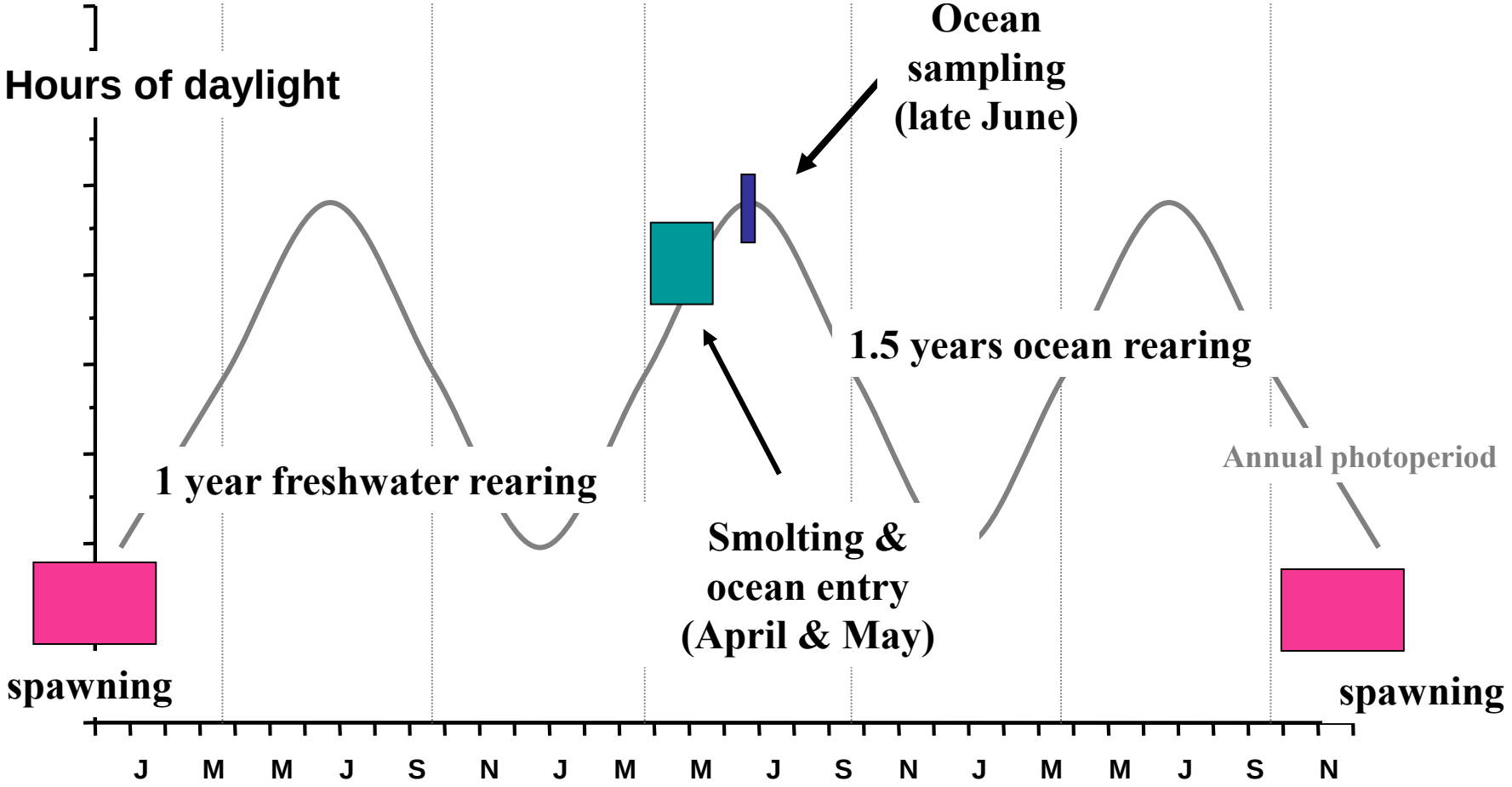
# Juvenile Salmon Ocean Ecosystem Survey
# JSOES




**June**
**1998 - 2017**

**CTD**
**Plankton**
**Fish**

# Ocean sampling occurs soon after ocean entry

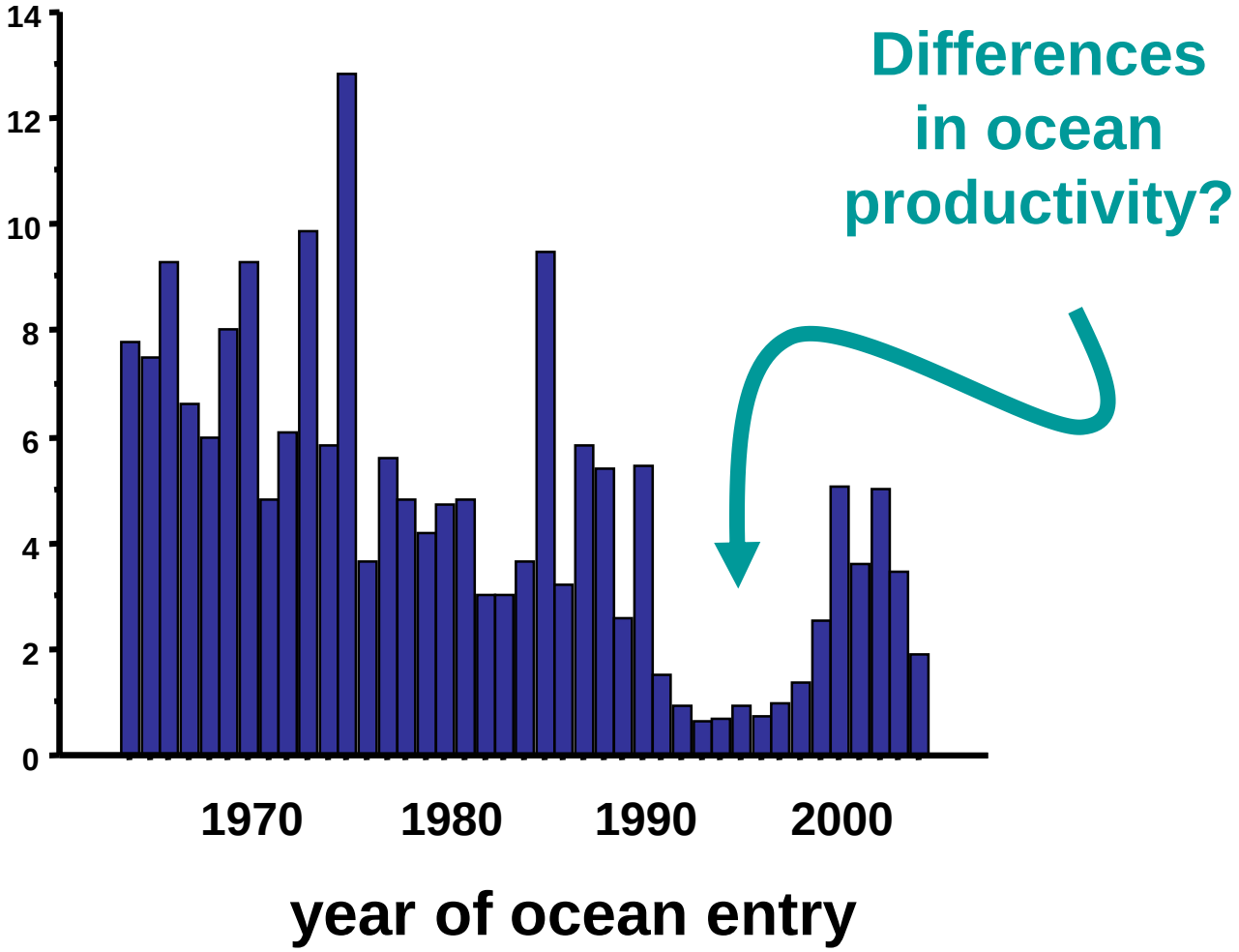



Coho salmon life history

# Coho salmon marine survival varies widely

**Survival of Columbia River coho salmon (%)**

$$\left(\frac{\text{\# adults}}{\text{\# smolts}}\right)$$




**Differences in ocean productivity?**

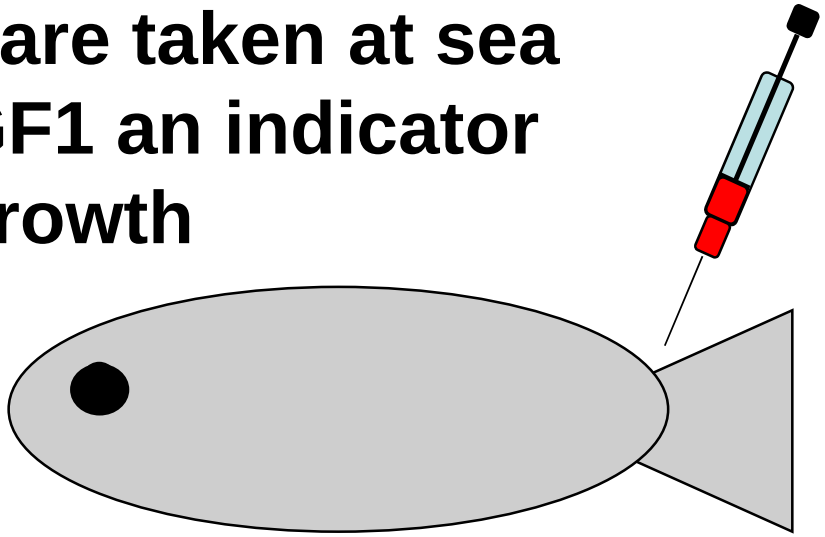
NW United States

**Hypothesis:**

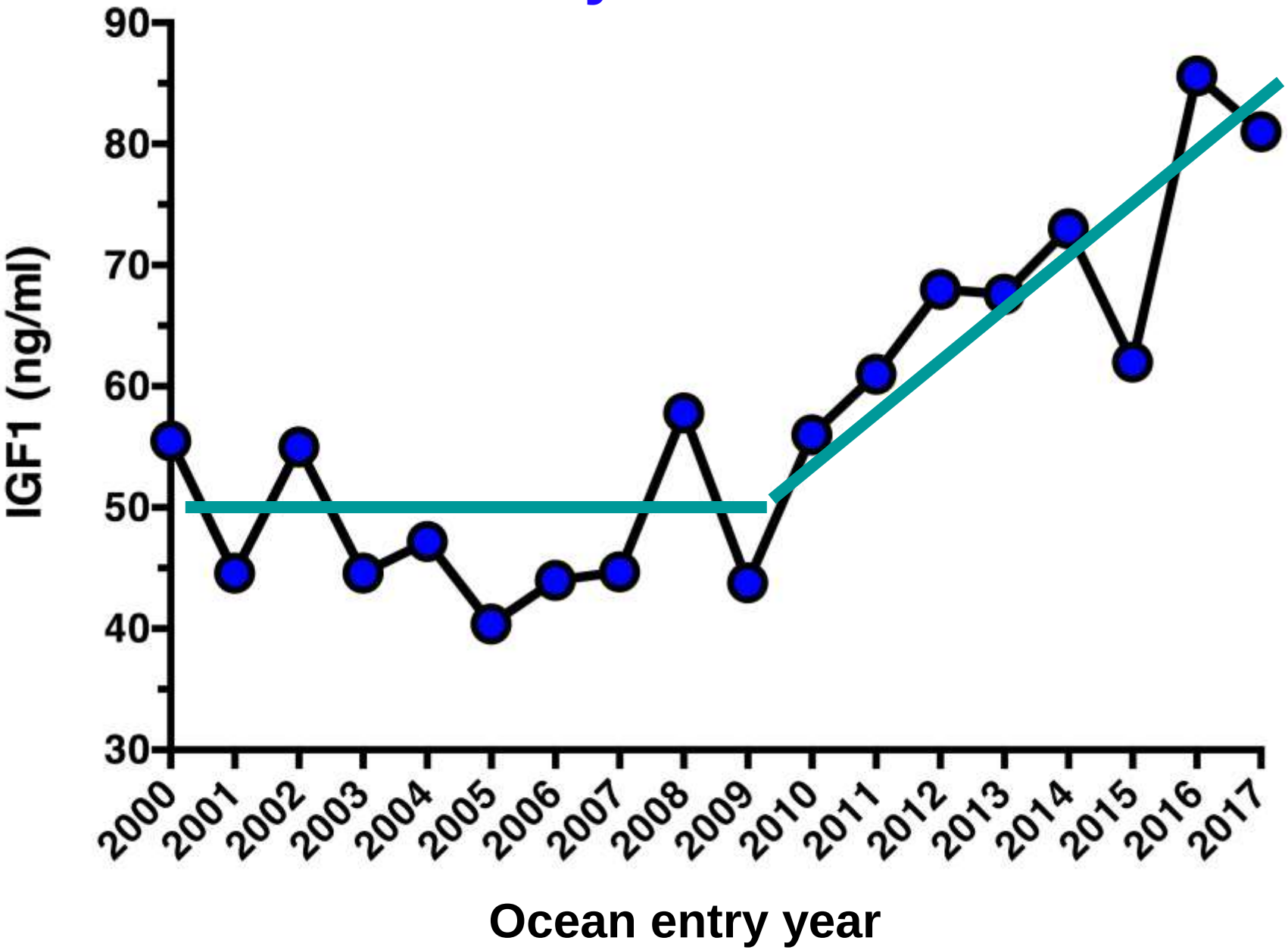
**Marine survival of juvenile salmon is directly related to early growth in the ocean**

**(Ocean Ecology of Pacific Salmon, Pearcy 1992)**

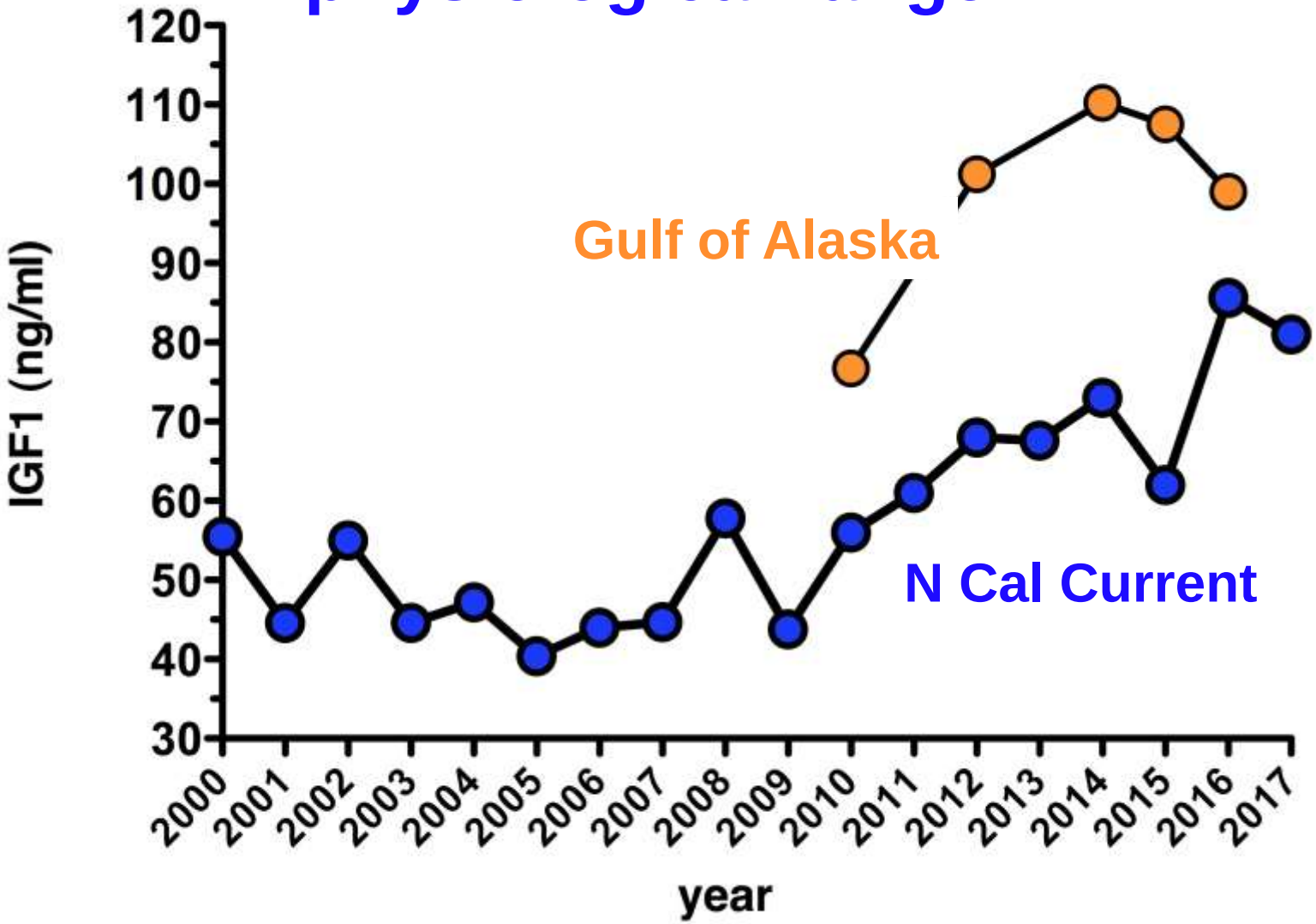
# Blood sample are taken at sea to measure IGF1 an indicator of growth



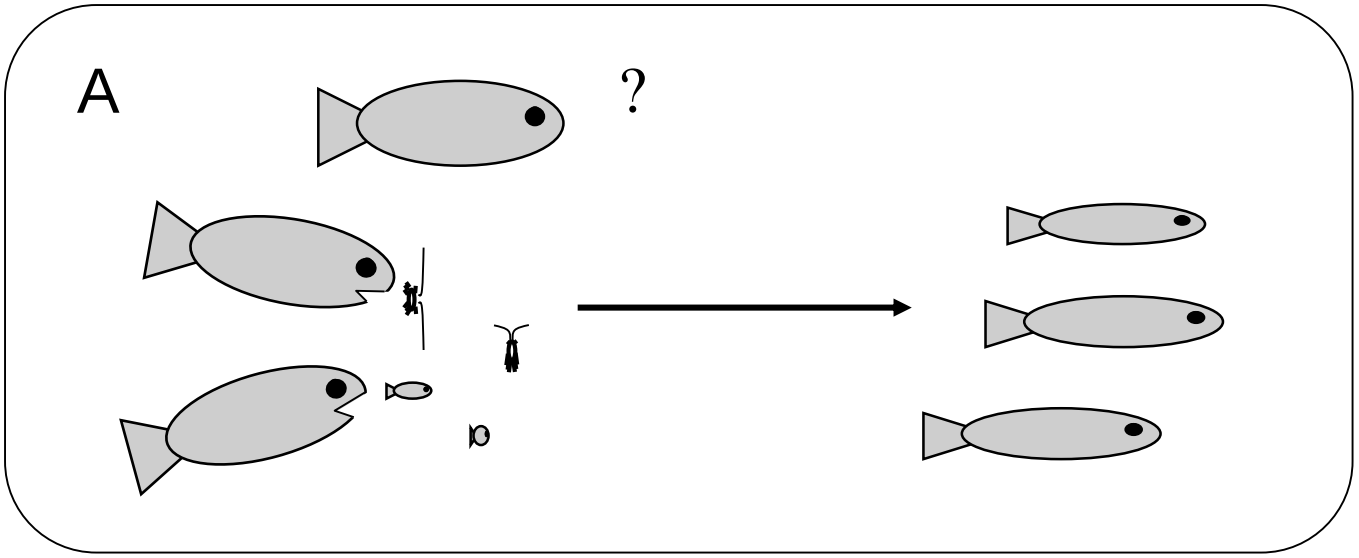
# IGF1 levels vary and then increase

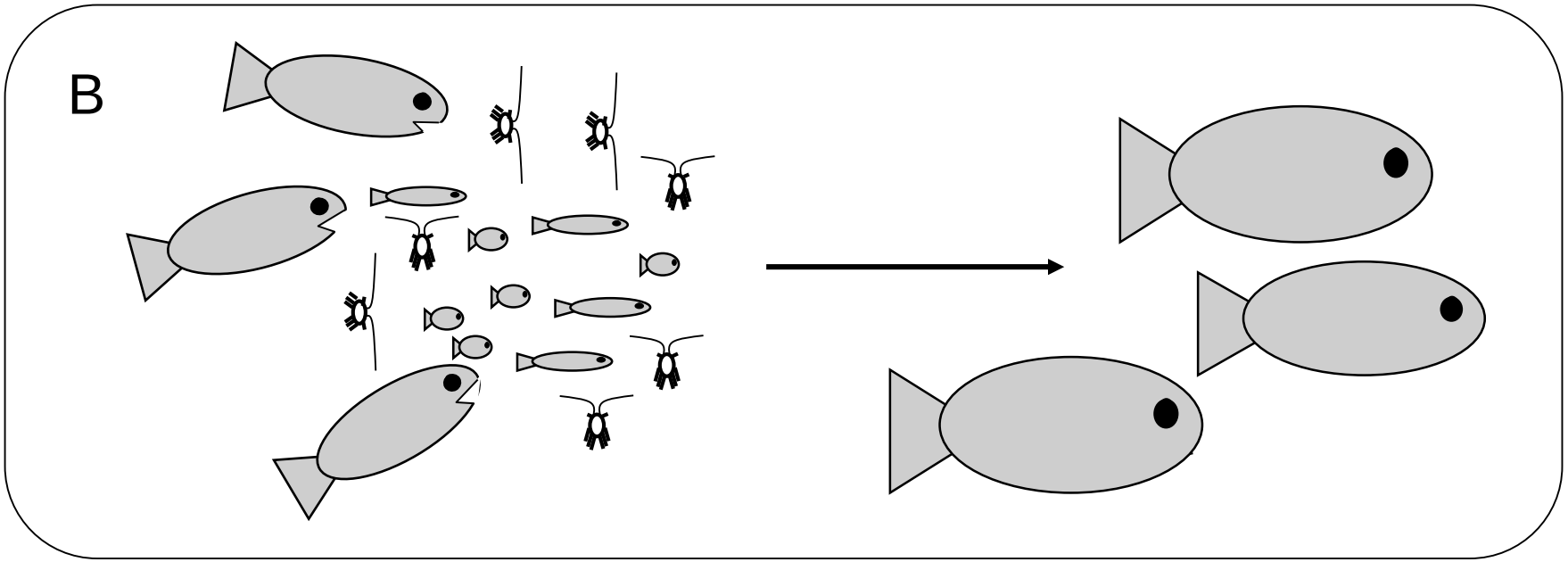


# Recent IGF1 values are well within physiological range



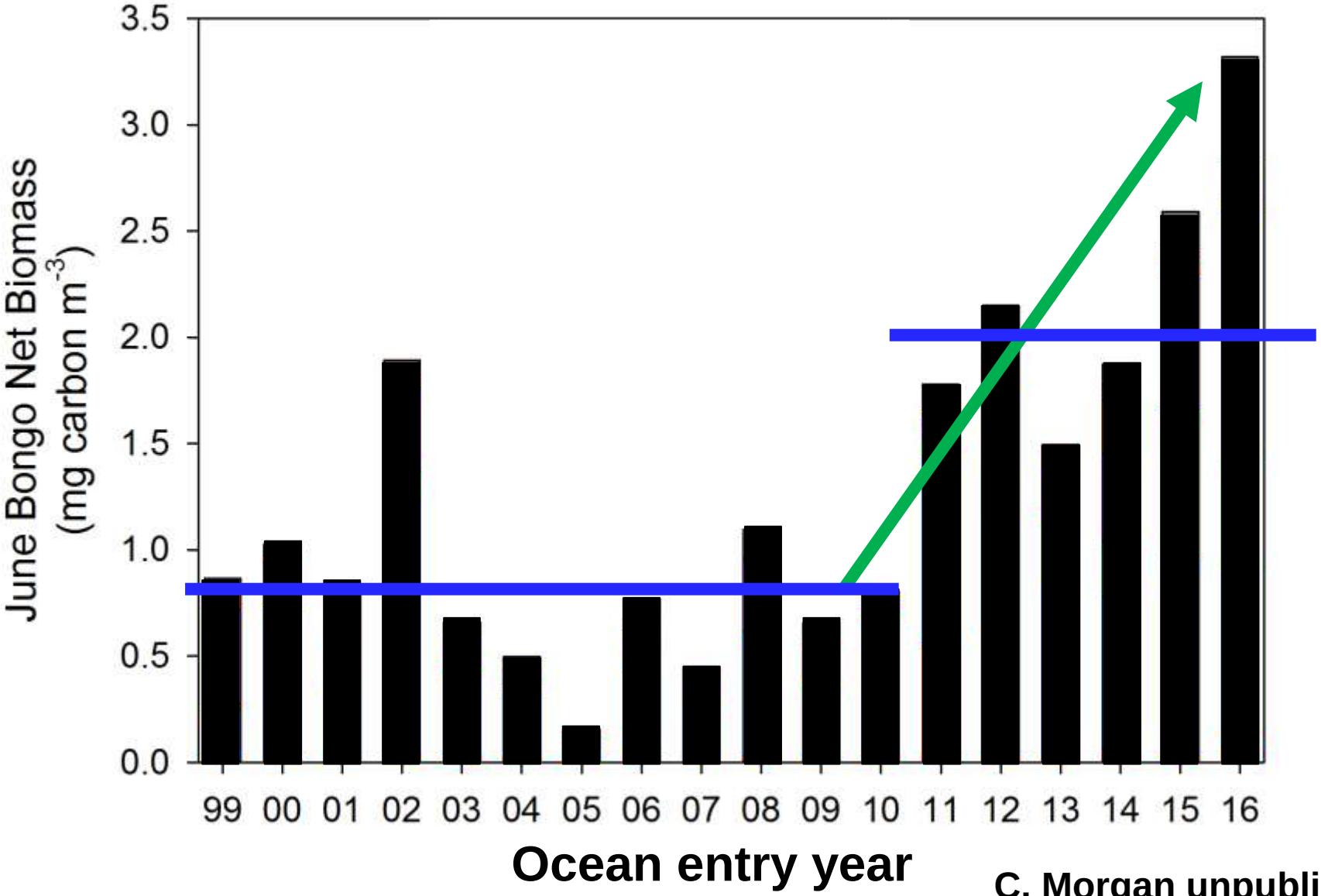
# What causes growth to vary?



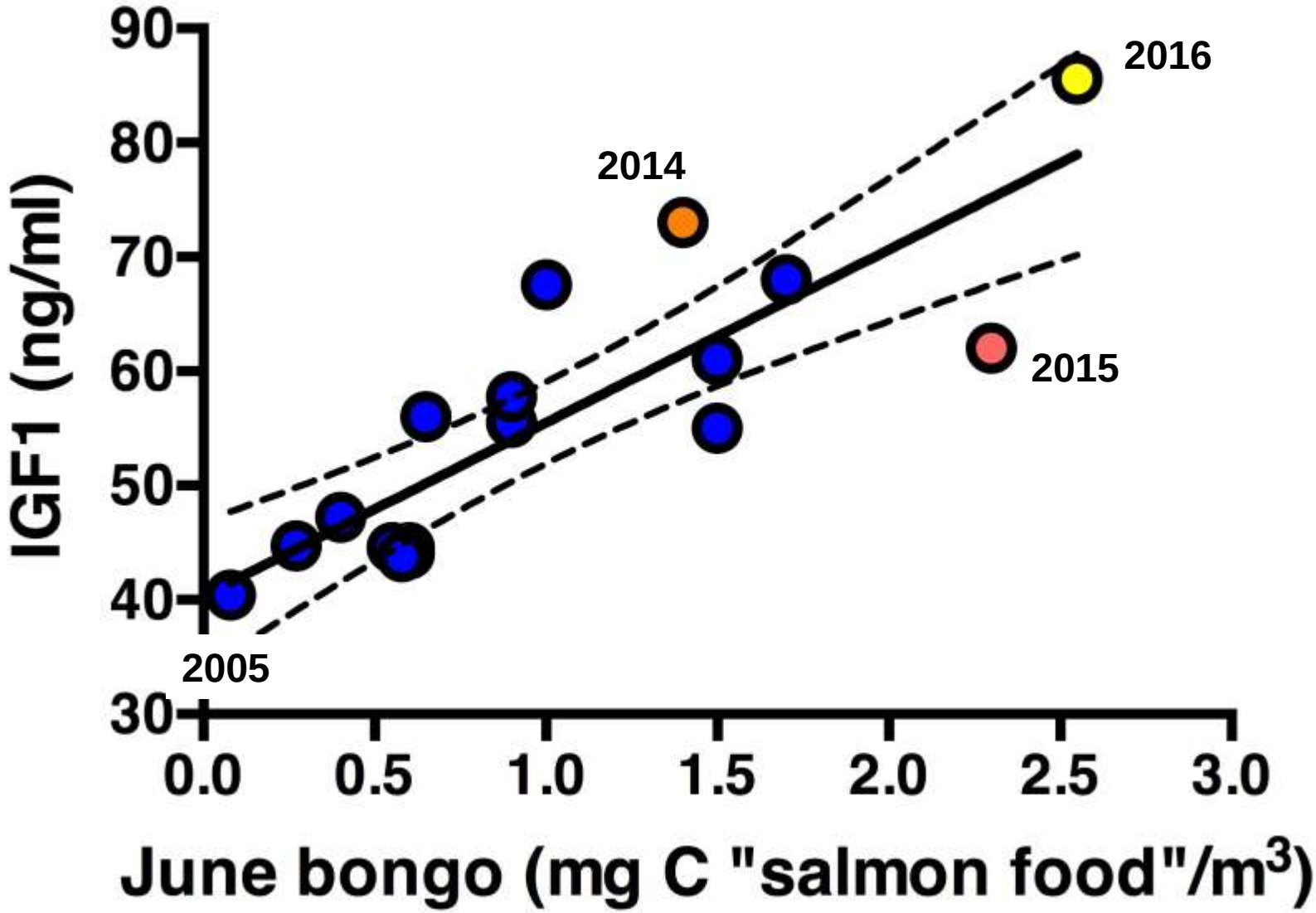
# Measuring salmon food

# Bongo Biomass varies and then increases

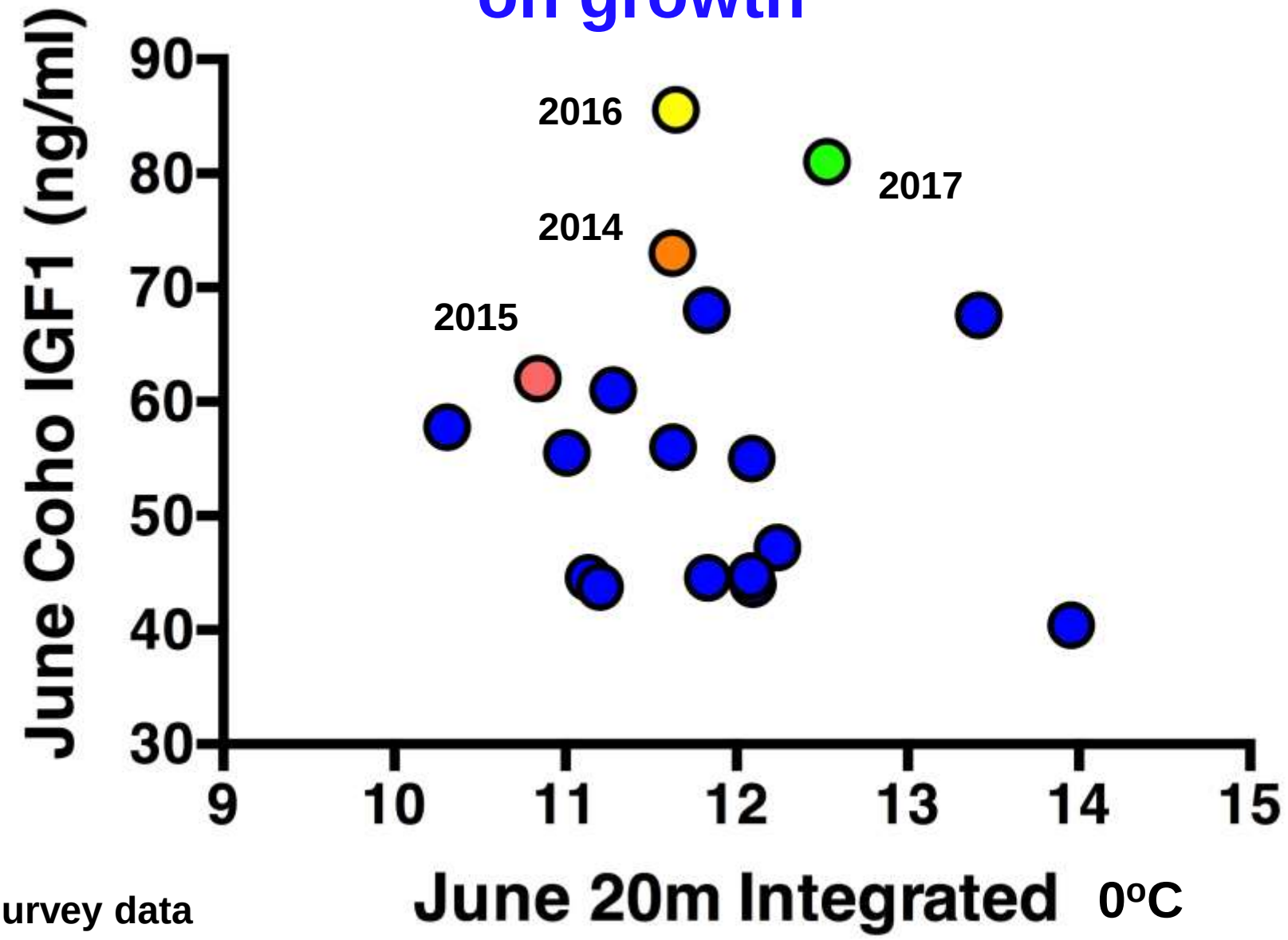



C. Morgan unpublished

# Growth is correlated with bongo prey field



# Little apparent affect of water temperature on growth



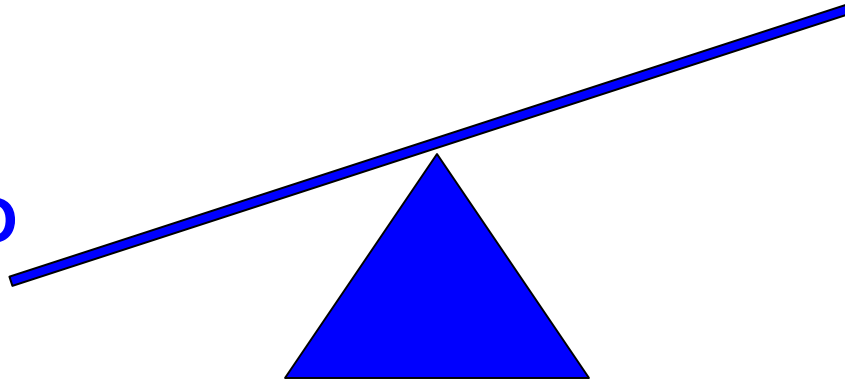

Survey data

# The PDO* paradigm for the N Cal Current

**Ocean =**

**Warm**
**Nutrient poor**
**Scarce, small, skinny prey**
**Low salmon survival**

**+ PDO**



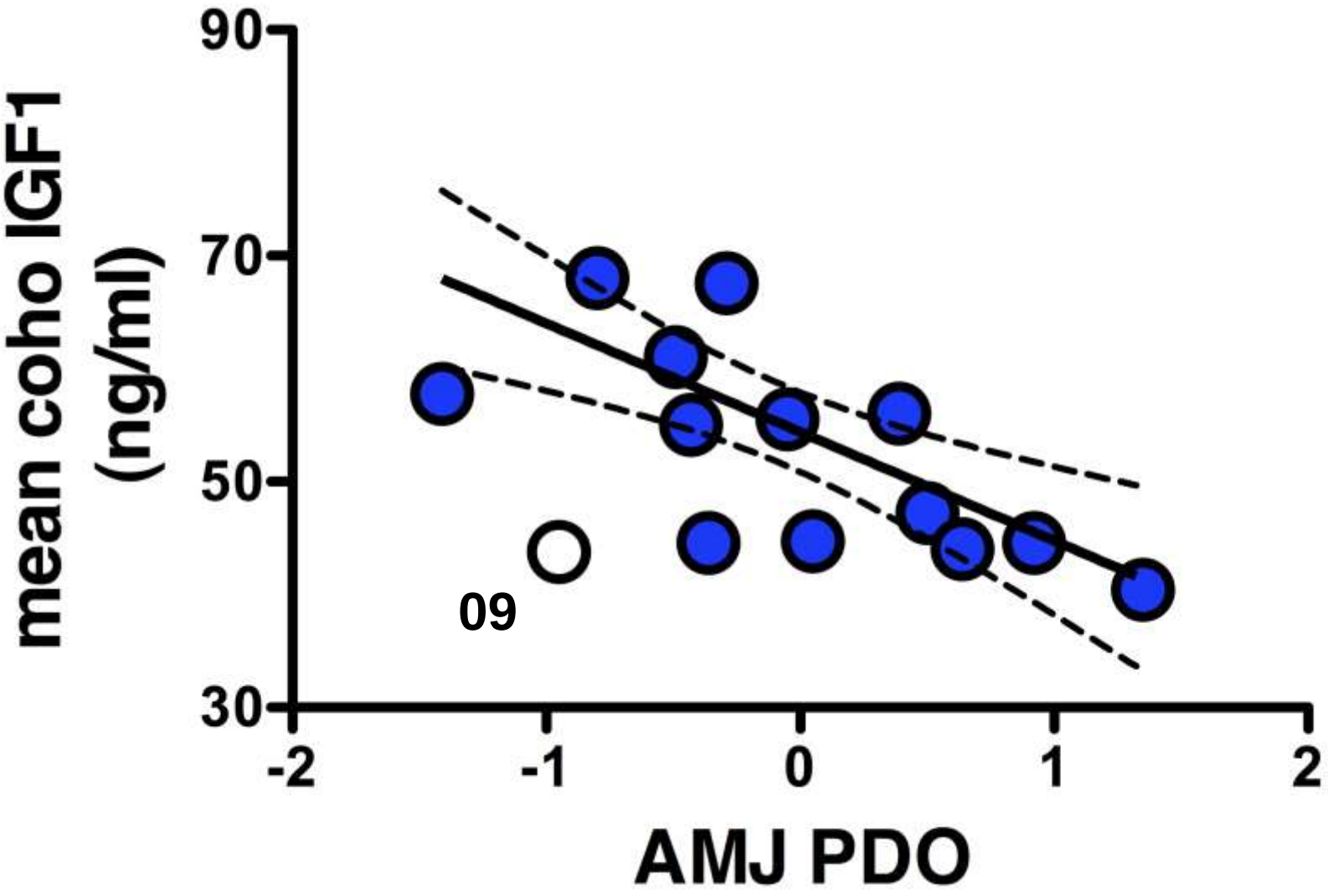
**- PDO**

**Ocean =**

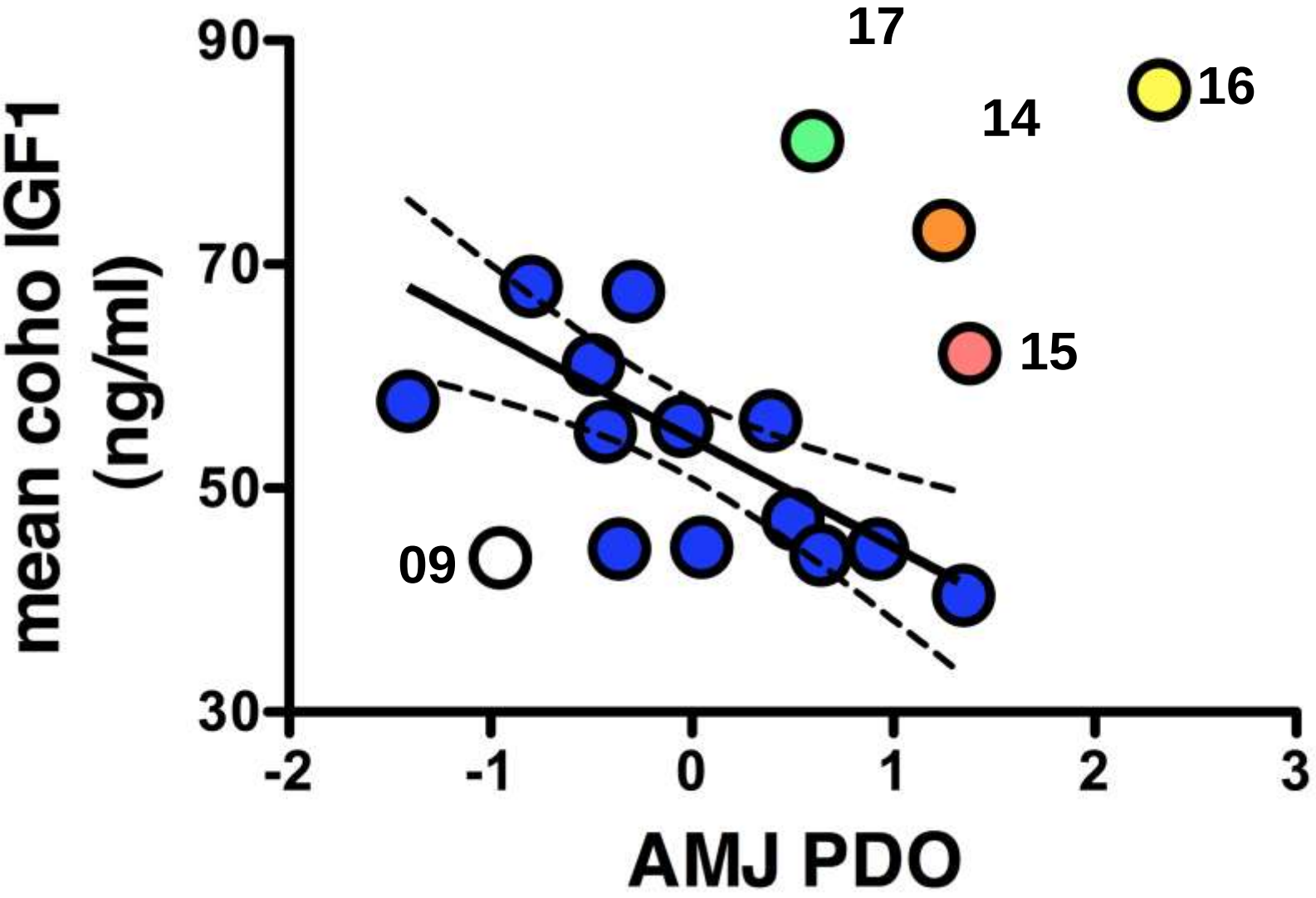
**Cold**
**Nutrient rich**
**Abundant, large, lipid rich prey**
**High salmon survival**

***Pacific Decadal Oscillation**

# IGF1 is correlated with PDO



# IGF1 was correlated with PDO



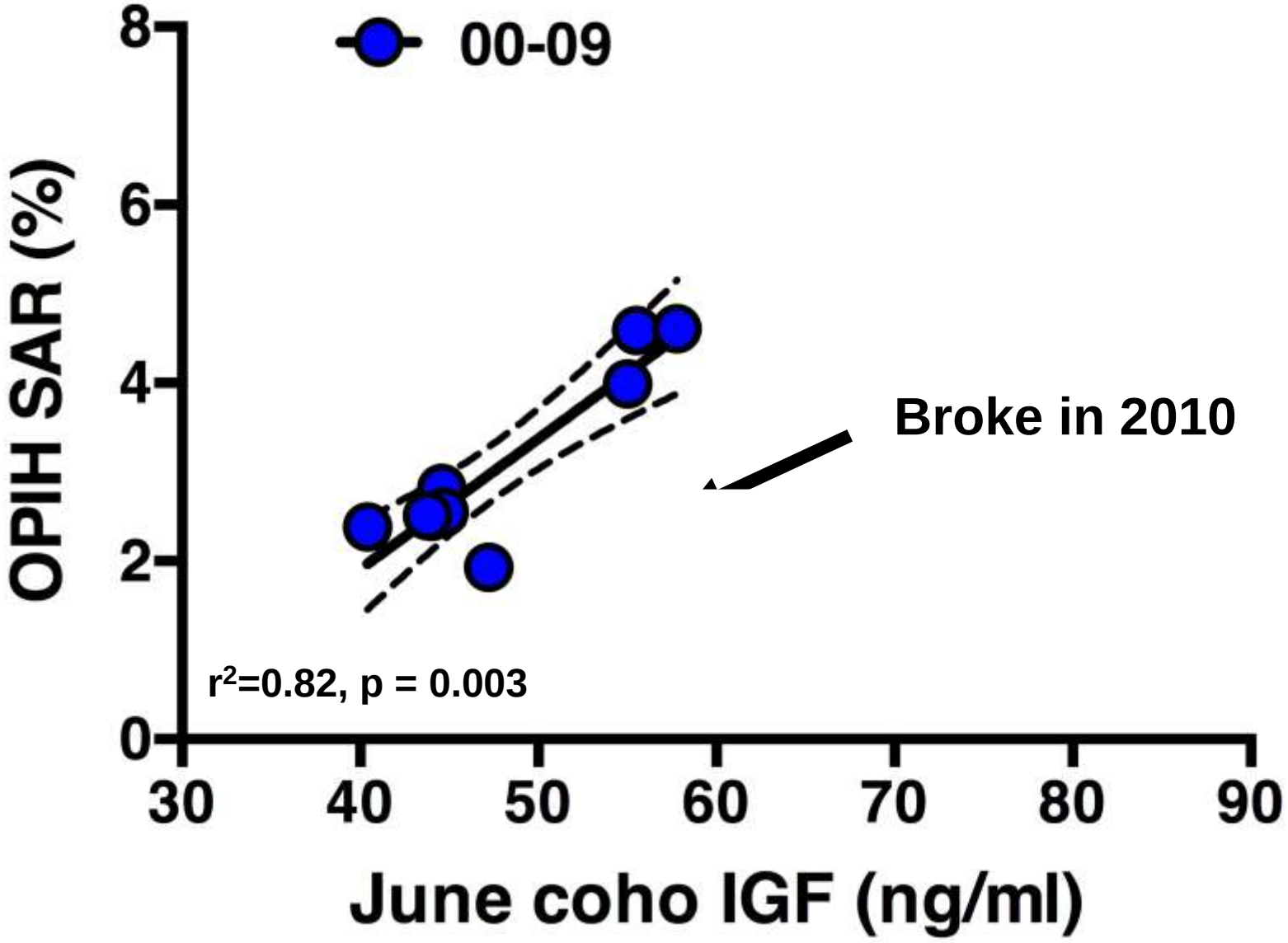
**> IGF1 is related to bongo prey field biomass**

- **Both IGF1 and prey field have increased since 2011**

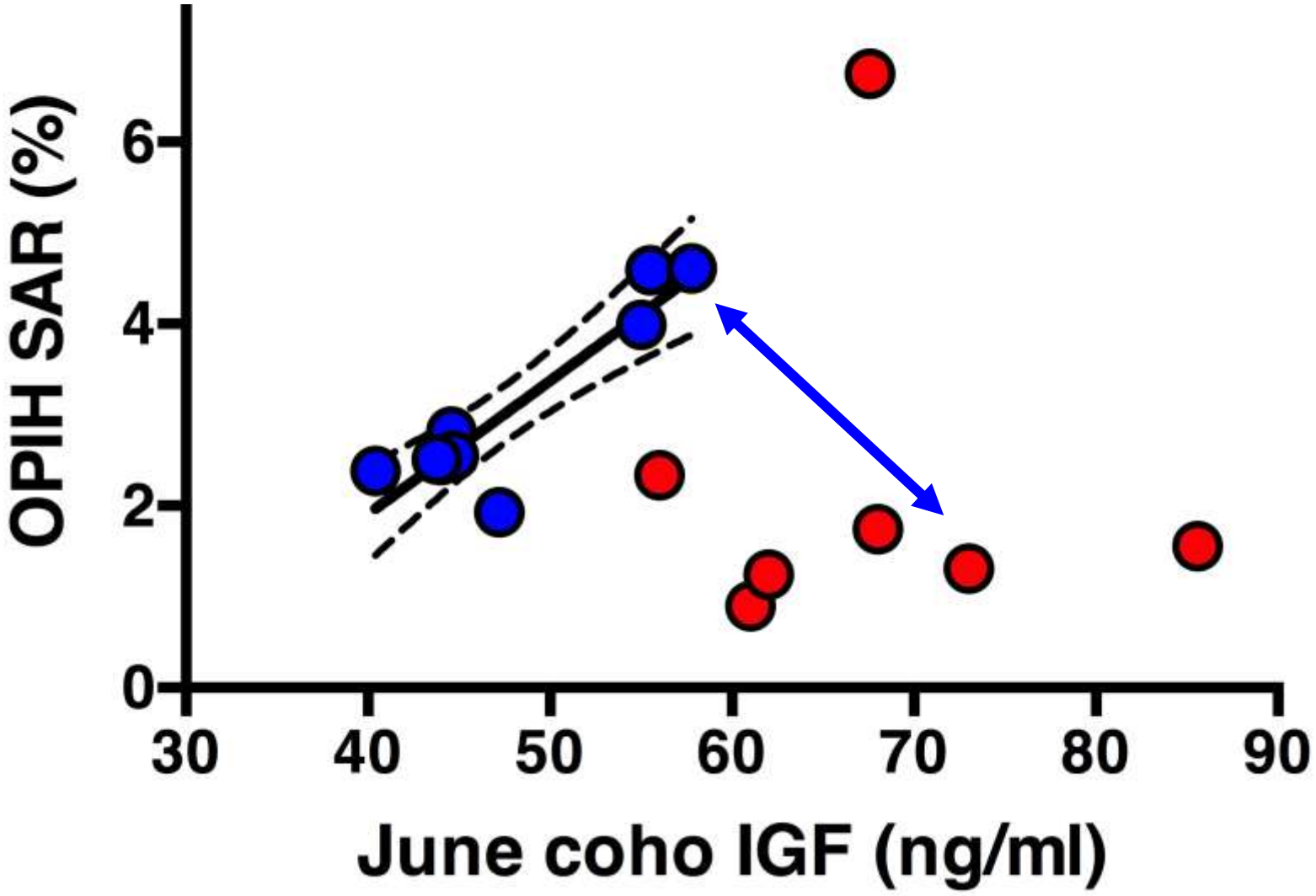
- **The highest IGF1 and Bongo Biomass measures in the time series measured during period of positive PDO**

  - **This was a surprise**

# Growth is related to survival

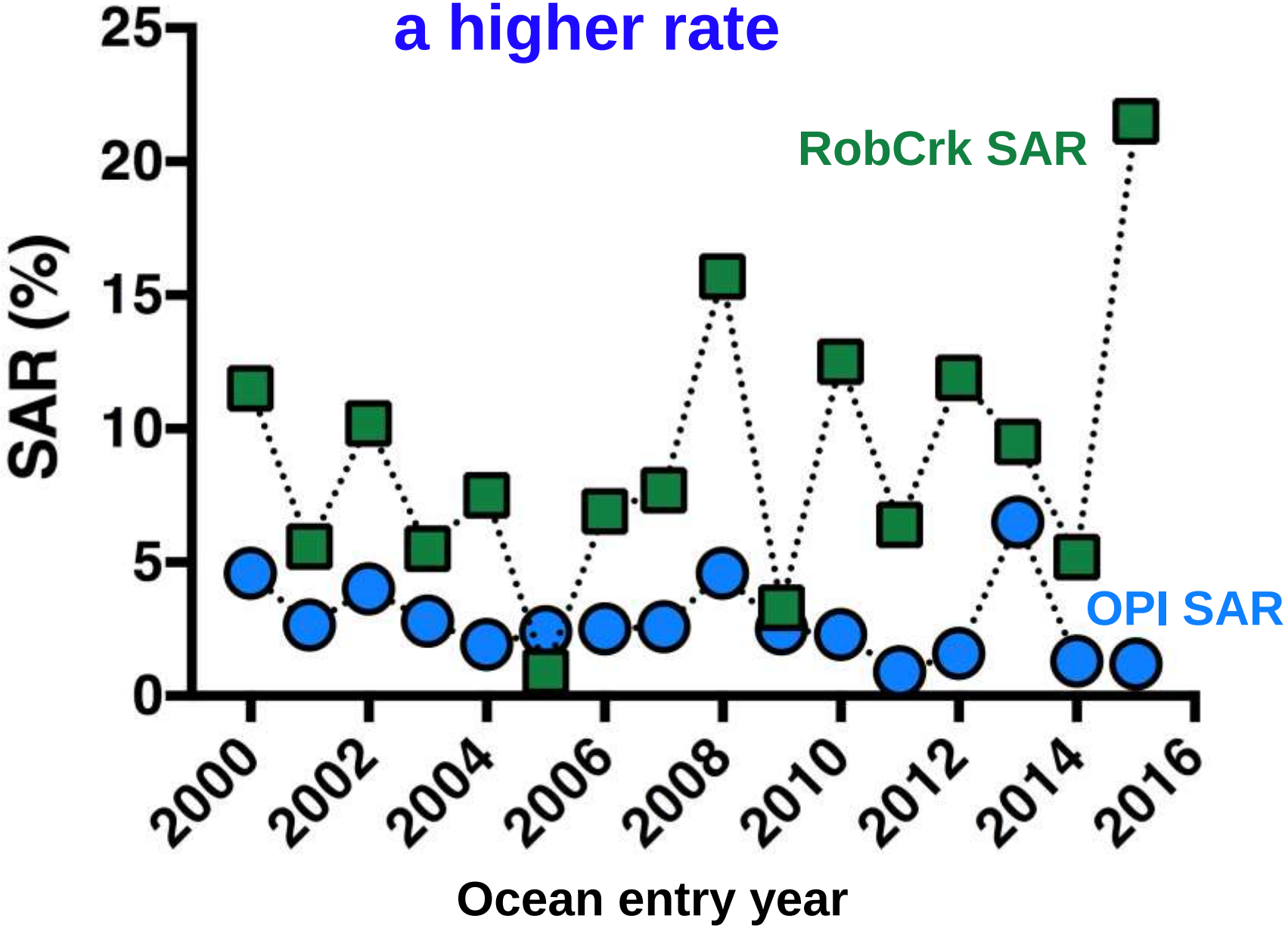


# IGF “never” underestimates SAR
# “deviation” all negative

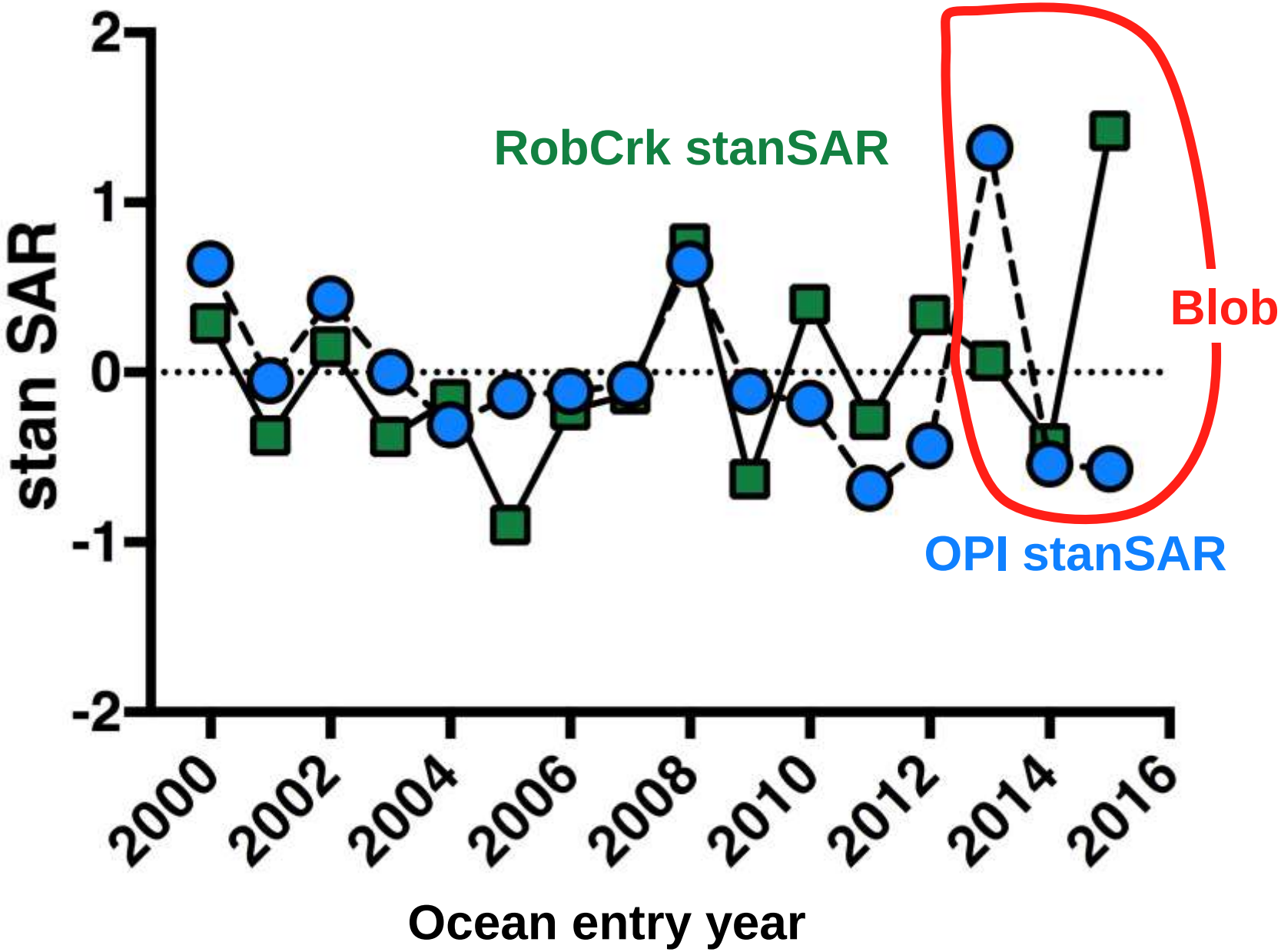


# Does it help to bring Canada into the discussion?

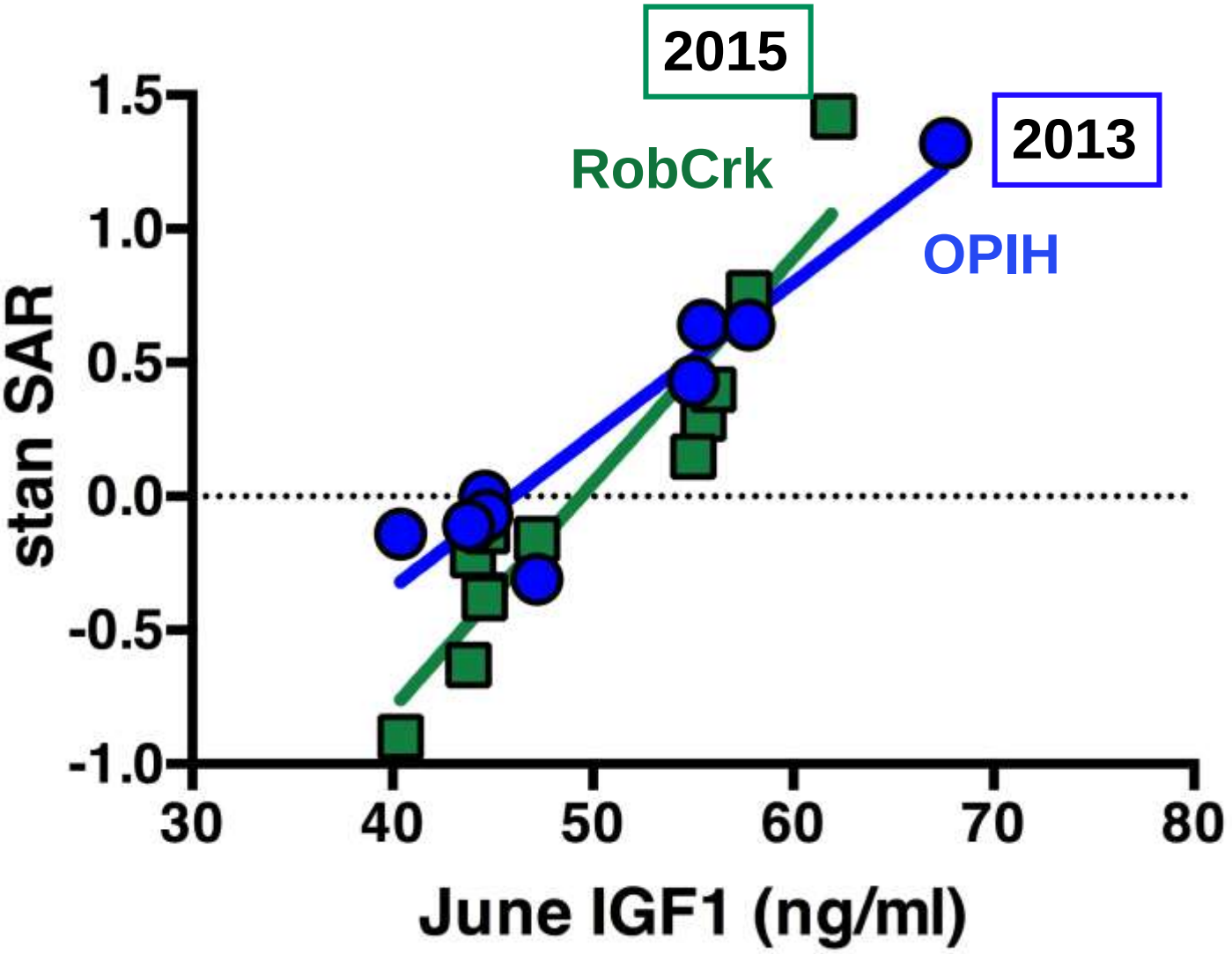
# Canadian coho salmon survive at a higher rate



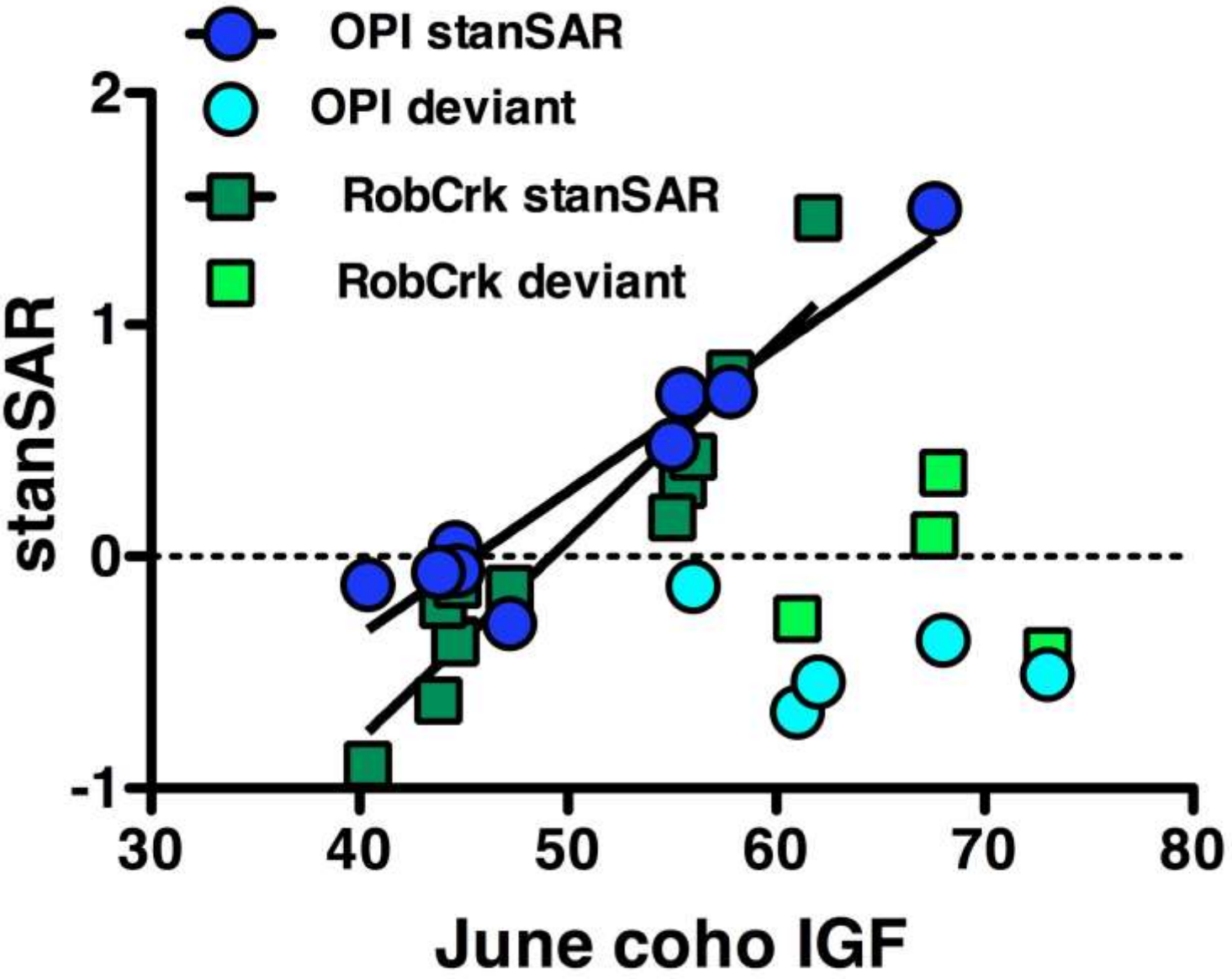
# stanSurvival trend is semi-coherent



# There is a good correlation between June IGF-1 and both OPIH and RobCrk SAR

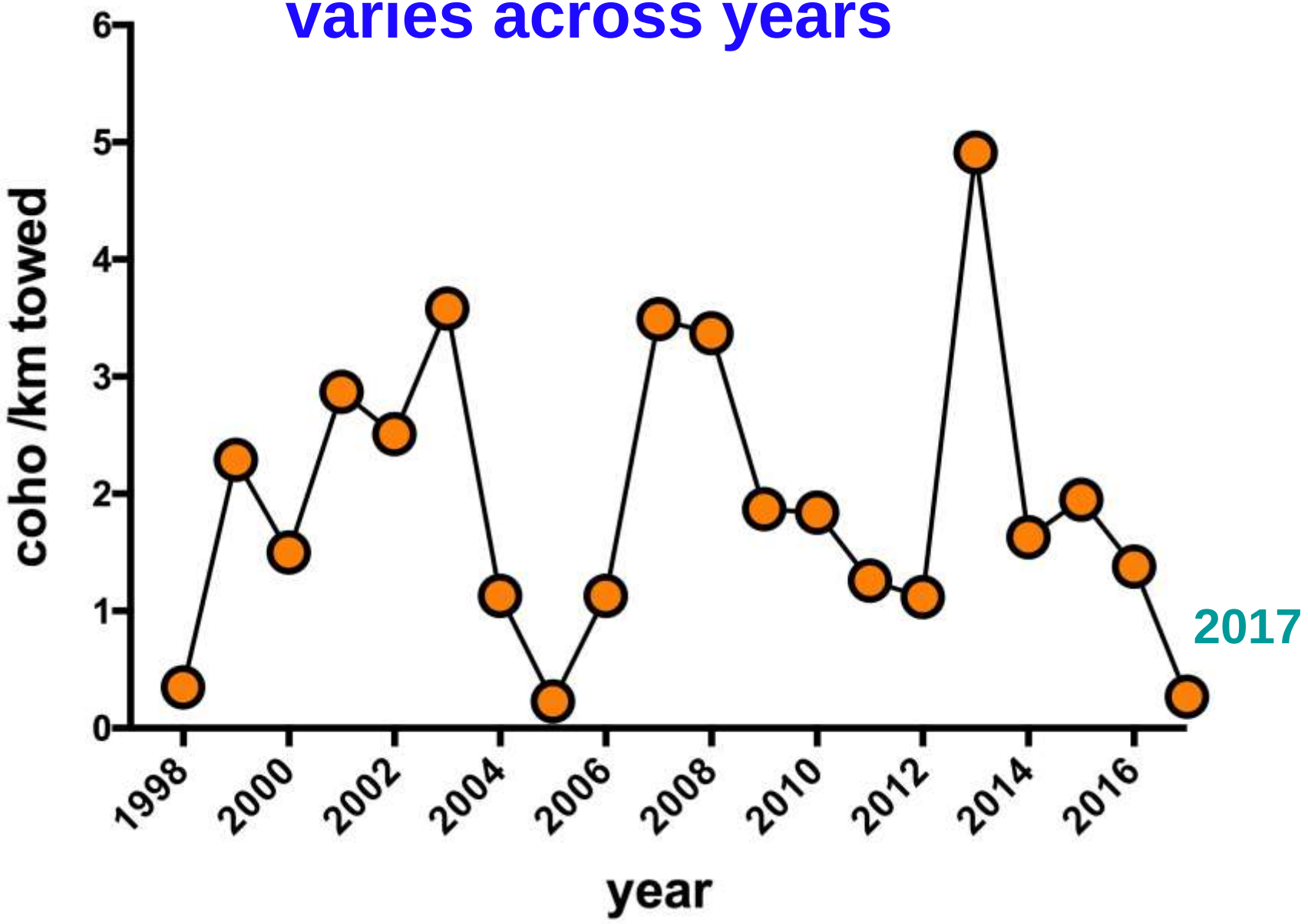


# Sometimes

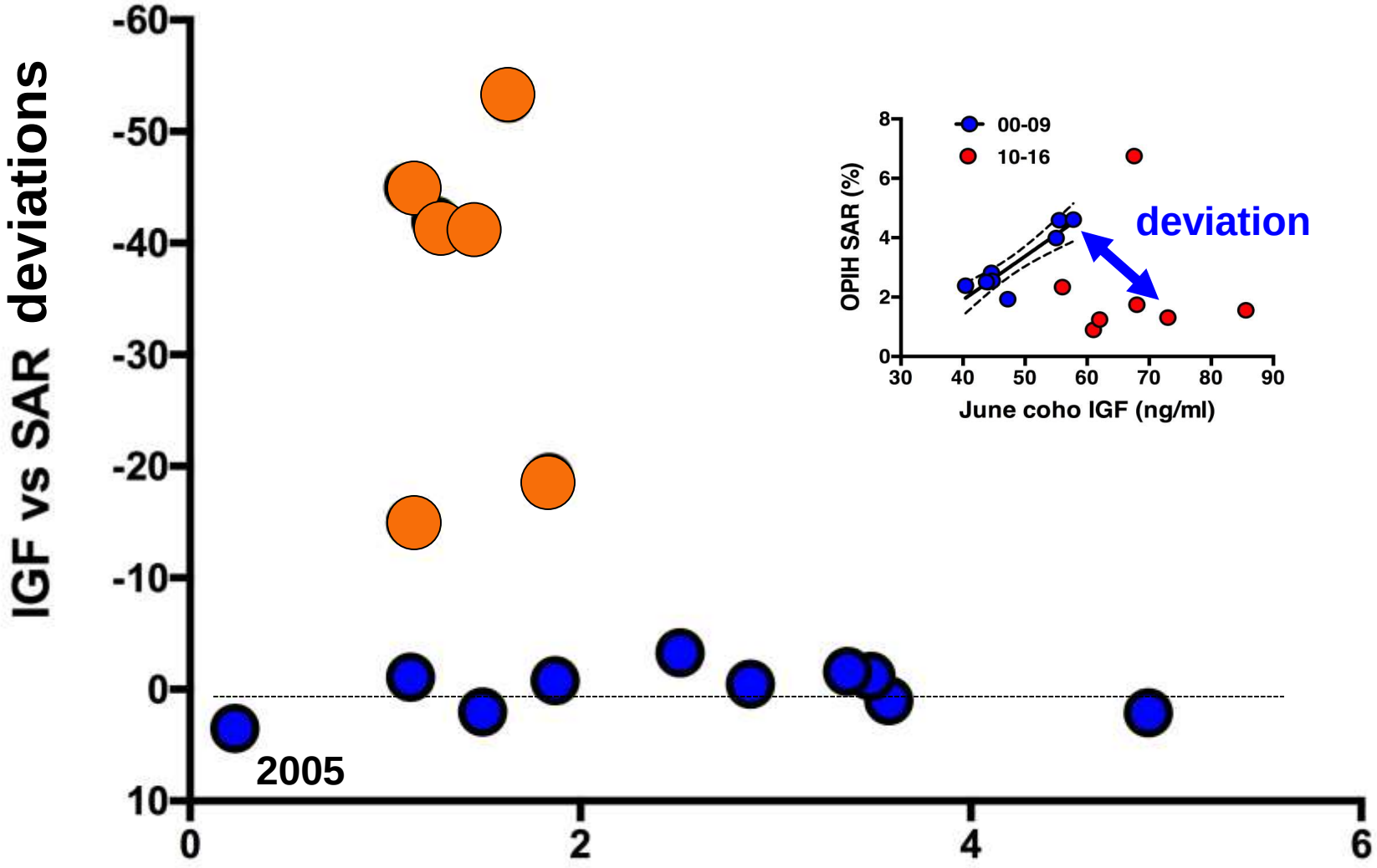

OPI stanSAR
OPI deviant
RobCrk stanSAR
RobCrk deviant
stanSAR
2
1
0
-1
30
40
50
60
70
80
June coho lGF

# Why negative deviations?

# Abundance of juvenile coho in June varies across years

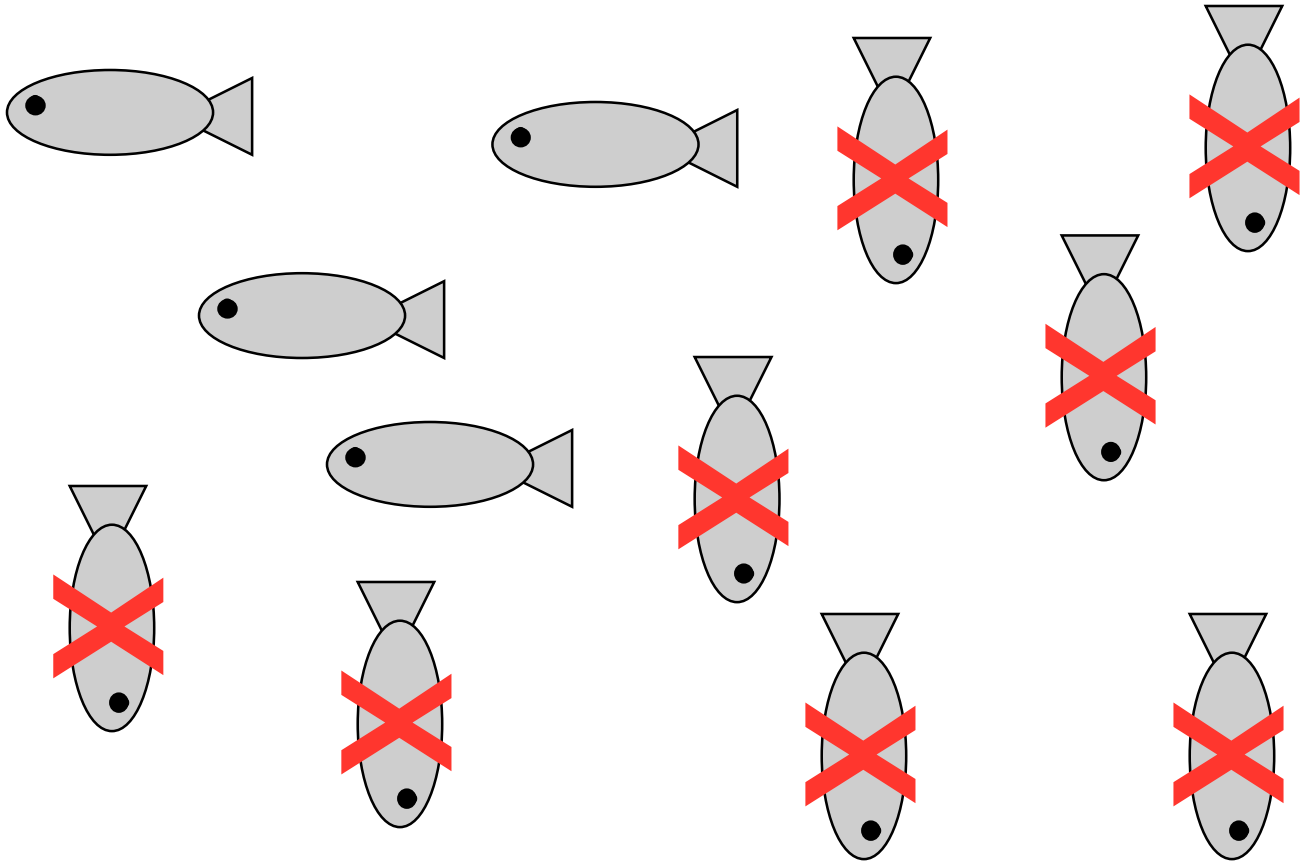


# IGF-SAR “negative deviations” all found at low June CPUE




=> Early mortality may limit overall survival

# Some years most of the fish are dead by June and subsequent growth doesn't matter

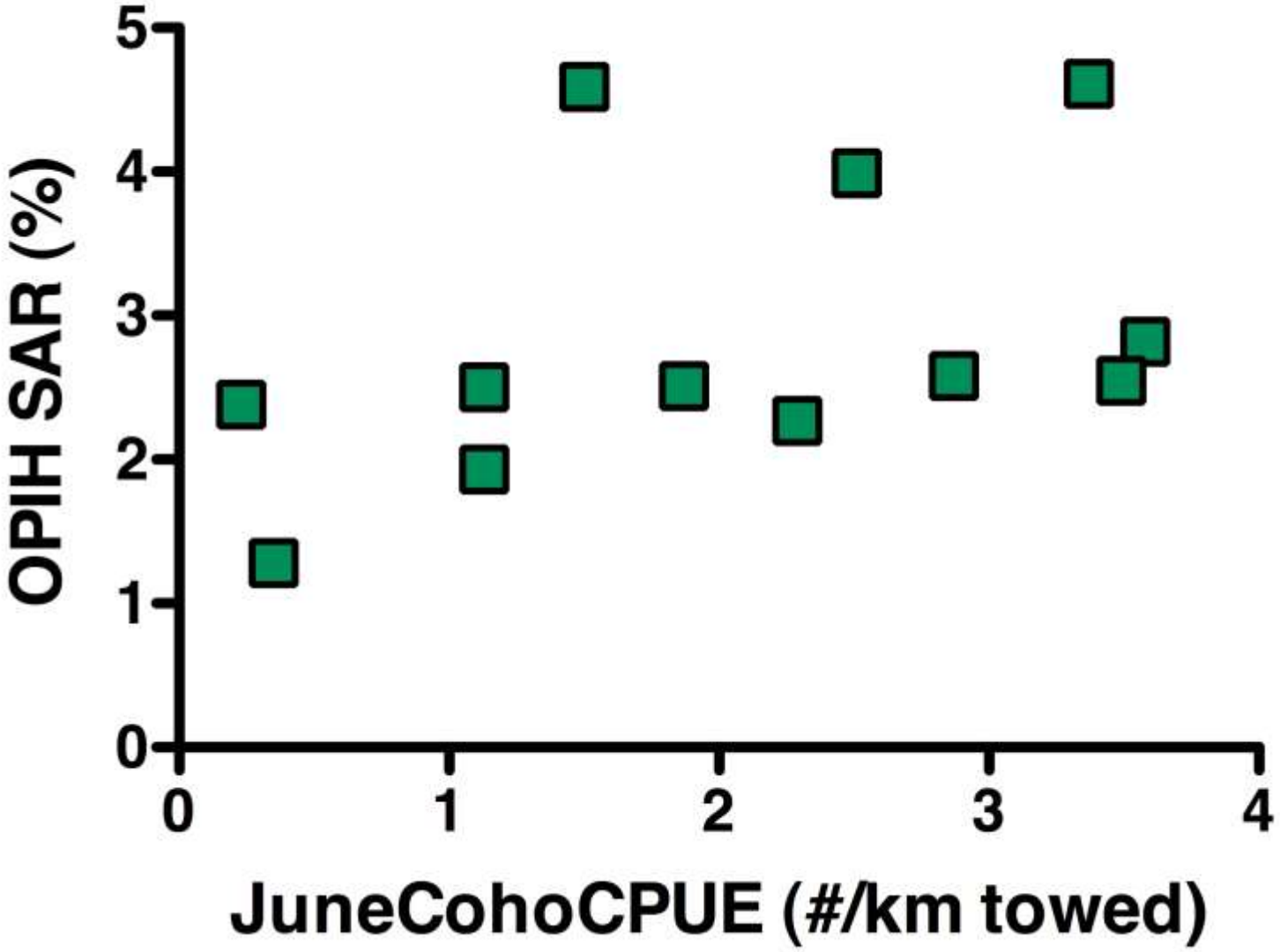


# Early marine mortality

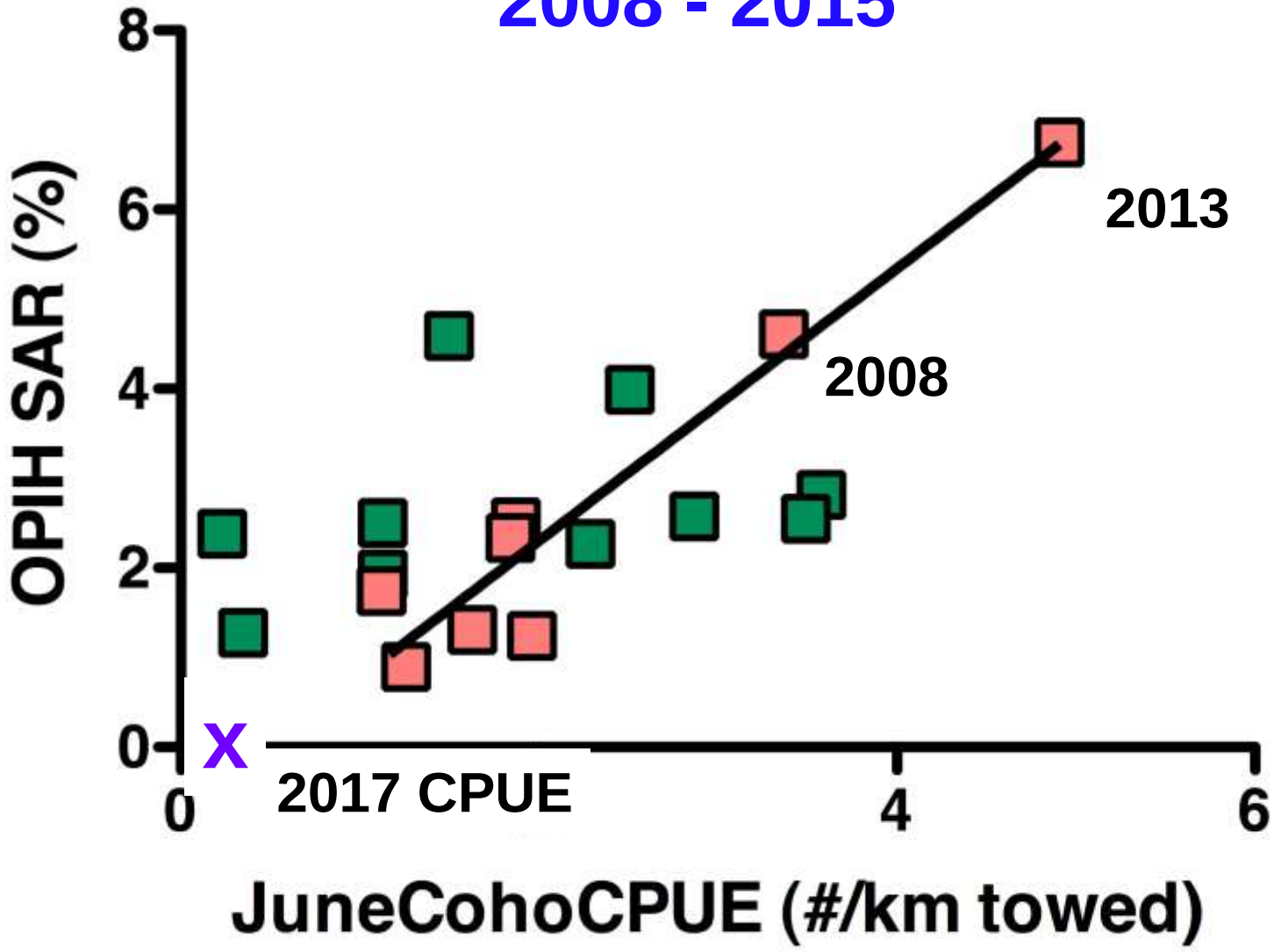
## Variation in CPUE may be an index of survival

## Parker et al. 1966

# June CPUE of coho is not related to SAR 1998 - 2007



# June CPUE of coho is related to SAR 2008 - 2015



**Suggests coho survival (SAR) is a result of several steps:**

1. **Early abundance (June CPUE)**
2. **Summer growth**
3. **Blob ??**

**Ecological processes vary in time and space**

**Sufficient temporal and spatial data need to be obtained to determine patterns**

**Patterns change**

# Acknowledgments


- **Funding from Bonneville Power**
- **Captain and crew of the F/V Frosti**
- **Numerous colleagues and collaborators**